Beliefs about Teaching Science: The Relationship between Elementary Teachers' Participation in Professional Development and Student Achievement

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Abstract

Because of increasing calls for school accountability, an increased emphasis placed on the role of the teacher, and theoretical connections between teacher beliefs and classroom action, a critical need exists to examine teacher professional development programs to determine their impact on teacher belief systems, teaching practices, and student learning. The primary goal of this study was to assess elementary teachers' science teaching efficacy as they participated in a large scale professional development program and to determine the relationship of these beliefs with student learning. It was found that elementary teachers who participated in a long-term, intense (over 100 contact hours annually) science professional development program displayed significant gains in their science teaching self-efficacy. Several background variables were found to be predictive of teacher beliefs including how often teachers spend teaching science. Males tended to display more positive beliefs than their female counterparts. Although a small portion of the variance was explained, teacher beliefs and the number of hours participating in the research-based professional development program were significantly predictive of students' science achievement. Other factors may be involved in teachers' beliefs and their connection with student learning including classroom practices, curriculum materials, support systems, and student background variables. These factors should be the target of future investigations.

Introduction

How school success is defined and how systems should proceed to structure in order to be successful is debatable. However, studies ranging from Goodlad's (1984) *A Place Called School* to more recent examinations of school effectiveness (e.g., National Commission on Mathematics and Science Teaching for the 21st Century, 2000; Townsend, 2007; Sammons, 2007) provide detailed recommendations which address multiple factors such as leadership, student backgrounds, curriculum, privatization, school resources, assessment, and teachers Using these recommendations as benchmarks, many school systems find that they need to systematically restructure in order to impact student learning.

While school effectiveness recommendations address a litany of factors, it is becoming increasing clear that teachers are critically important to the success of education reforms since they play such a key role in directly impacting student learning (Borko, 2004; Nye, Konstantopoulos, & Hedges, 2004; Fullan, Hill, & Crevola, 2006). The Teaching Commission (2004) stated that teachers are "our nation's most valuable profession" (p.12),

In light of the increasing emphasis placed on the importance of teacher quality and their professional actions, some reform efforts began to focus on improving teacher quality through professional development efforts. Teacher professional development as a means towards developing quality teachers is cited as a significant variable in determining school policy, setting classroom practices, and ultimately impacting student learning (Borko, 2004, Desimone, Smith, & Frisvold, 2007; Smith, Desimone, & Ueno, 2005; Desimone, Smith, Hayes, & Frisvold, 2005).

Teacher Professional Development

Many traditionally employed forms of professional development, such as one-shot in-service workshops, are woefully inadequate (Borko, 2004; Barber, & Mourshed, 2007; Lumpe, 2007; Darling-Hammond, Chung Wei, Andree, Richardson, & Orphanos, 2009). However, research within the past decade began to reveal that effective teacher professional development, as a form of adult learning, has the potential to serve as a key school organizational component for the improvement of teaching and student learning (Elmore, 2007; Fullan, 2007). Realizing its potential, Borko (2004) called for continued research to understand the key elements and interactions of effective teacher professional development.

In a detailed analysis of 25 teacher professional development programs, Blank, de las Alas, & Smth, (2008) found that among programs that demonstrated positive impacts on student outcomes, several features were present including over 50 hours or more of professional development, continuous coaching and mentoring for teachers, alignment of curriculum, and ongoing teacher collaboration. In a comprehensive review of research, Yoon, Duncan, Lee, Scarloss, & Shapley (2007) also found that the duration of professional development demonstrated positive and significant impact on student learning. In summarizing research on effective teacher professional development, Darling-Hammond and Richardson (2009) argued that successful programs are sustained over time, collaborative, focused on the content to be taught, and provide multiple opportunities for classroom application.

Based on the earlier research of Garet, Porter, Desimone, Birman, & Yoon (2001), Desimone (2009) proposed a model of teacher professional developement that includes the following core features: 1. focus on content to be learned by students, 2. active learning during the professional development experiences, 3. coherence of the learning to teachers' professional needs, 4. occurrence over a long duration, and 5. collective participation by educators in their professional learning. When these features occur in a sustained manner, it is proposed that teachers' knowledge, skills, beliefs, and attitudes will improve thereby increasing student learning. All of this must occur in the context of a supportive school system which includes curriculum, leadership, and policy. Guskey (2002) proposed a similar model where effective professional development would lead to improved professional practices, which would in turn lead to improvements in student learning. While both Desimone and Guskey cite the importance of teacher beliefs and attitudes in the professional development process, Desimone include these affective variables as part of the development process where Guskey lists them as outcomes after student learning occurs.

Loucks-Horsley, Love, Stiles, Mundry, and Hewson (2003) proposed a professional development model for science and mathematics in which they contend that teachers' environmental context and beliefs directly impact goals and plans ultimately leading to specific actions in the classroom. Actions, depending on their effectiveness, may assist or deter student learning. They noted that self-reflection by teachers provides a feedback loop for goal modification. For example, one cannot simply give quality science curriculum materials to a teacher and expect quality science instruction. Their model supports Haney and Lumpe's (1995) contention that science teachers' beliefs must be identified and clarified prior to, and during professional development activities.

In addition to a myriad of process factors related to effective professional development, all of the models described above identify the critical nature of the motivational beliefs of teachers. According to Bandura (1997), beliefs are thought to be the best indicators of the decisions people make throughout their lives. Teachers of science possess beliefs regarding their professional practice which may in turn, impact student learning. Recently, researchers began to document this connection between teacher beliefs and student learning (e.g., Goddard, Hoy, & Hoy, 2004; Ross, Hogaboam-Gray, & Hannay, 2001).

Theoretical Background on Teacher Beliefs

In his Motivation Systems Theory, Ford (1992) argues that competence in any given area (i.e., science teaching) is a combination of a person's motivation, skill, and environment. Motivation, he further clarified, is composed of goals and personal agency beliefs. Goals "are thoughts about desired states or outcomes that one would like to achieve" (p. 248). In this particular investigation, the target goal is effective science teaching. According to Ford, personal agency beliefs are evaluative beliefs comparing a person's goals with the consequences of their pursuit of those goals. Ford (1992) stated:

> *…personal agency beliefs play a particularly crucial role in situations that are of the greatest developmental significance-those involving challenging but attainable goals. Consequently, they are often key targets of intervention for parents, teachers, counselors, and others interested in promoting effective functioning. (pp. 124-125)*

Ford's theory identifies two types of personal agency beliefs, capability and context. Capability beliefs are synonymous with Bandura's (1997) concept of self-efficacy. Capability beliefs are beliefs about one's ability or skill to meet a particular goal. In the context of this study, this would be characterized as a teacher's belief that they can effectively teach science. Bandura further delineated a related belief construct called outcome expectancy. He stated, "…outcome expectation is a judgment of the likely consequences such performances will produce" (1997, p. 21). For an elementary teacher, this would be a belief that if one teaches science effectively, then students will learn science.

Context beliefs are beliefs about the responsiveness of the environment (external factors and/or people). Context beliefs are sometimes called perceptions of control. They are similar to Ajzen and Madden's (1986) perceived behavioral control construct and Bandura's (1997) outcome expectancy construct. Context beliefs include the role of the entire context in meeting desired goals. In the case of science teaching, context beliefs would not only encompass the students, but also administrators, parents, other teachers, institutions, organizations, and the physical environment. In education, contexts can be broadly classified into the designed environment (e.g., buildings, equipment), human environment (e.g., students, faculty, parents), and socio-cultural environment (e.g., policy, cultural norms) (Ford, 1992).

Since teacher beliefs serve as one important factor in the goal of teaching effectiveness, they recently became the target of professional development programming. In a study of a teacher professional development program, Rosenfeld and Rosenfeld (2008) found that mediated professional development activities caused an increase in teacher beliefs about student learning. They concluded that teacher professional development should be linked to teacher belief systems. Ross and Bruce (2007) conducted a comparison of teacher professional development programs on teacher's efficacy. They found that treatment teachers outperformed control group teachers on one measure of efficacy. They suggested that researchers examine connections between teacher beliefs and student achievement.

Because of increasing calls for school accountability, an increased emphasis placed on the role of the teacher, the role of professional development, and theoretical connections between teacher beliefs and classroom action, teacher professional development programs have the potential to impact teacher belief systems, teaching practices, and student learning. Therefore, the authors set out to measure teacher beliefs about teaching elementary science and determine relationships between those beliefs and student achievement.

Research Questions

The primary research goal was to assess elementary teachers' science teaching efficacy as they participated in a large scale professional development program. Specific related research questions included:

1. Do teachers' beliefs about teaching science improve after involvement in intense professional development?
2. What demographic factors predict teachers' beliefs?
3. Are teachers' beliefs about teaching science predictive of student achievement?

Context of the Project

The target of this study was a large scale teacher professional project comprising a collaborative partnership between a large urban school district, a smaller adjacent suburban district, and two large universities in Ohio, a Midwestern state of the USA. The project was designed to achieve a comprehensive, system-wide transformation of science education in grades kindergarten through sixth grade (K-6) and to improve science teaching and learning through sustained professional development of all K-6 teachers in the participating schools.

Both school districts faced severe challenges in raising student achievement in science, and the urban district was ranked as an "academic emergency" school district by the state's standards. At the time of the study, the enrollment of the urban district at the time of the study was 37,315 students, including 46.73% designated as qualifying for free or reduced lunch.

Nearly one third of its students were from single-parent homes and/or living below the poverty level. Of the system's nearly 40,000 students, 46.0% were African American, 45.1% were Caucasians, 6.7% were Hispanic, 1.3% multi-racial, and .01% other cultural groups.

The project included goals that aimed to improve science teaching and learning. The project was a direct application of the science teacher professional development models from Loucks-Horsley, Love, Stiles, Mundry, and Hewson (2003) and Haney and Lumpe (1995). A previously published report (Czerniak, Beltyukova, Struble, Haney, & Lumpe, 2006) provide great detail about the project activities. A brief description of components of the program that played a critical role in the implementation of systematic science reform is provided below. Wherever program components address Desimone's (2009) five characteristics of effective professional development listed earlier (*Content Focus*, *Active Learning*, *Coherence*, *Duration, and Collective Participation*), it is noted within the project description in parentheses.

Six, two-week-long Summer Institutes for classroom teachers were conducted each year of the project. Teachers participated in sessions that focused on inquiry-based instruction, science content knowledge, and science process culled from the districts' adopted curriculum (*Content Focus*). The adopted curriculum included the Full Option Science System (FOSS) developed by the University of California's Lawrence Hall of Science and Science, Technology, and Children (STC) developed by the National Science Resources Center (NSRC), an organization of the Smithsonian Institution and the National Academies. The Summer Institutes ran eight hours a day for two weeks for approximately total of 80 contact hours (*Duration*). The summer institutes were co-taught by science educators, Support Teachers (described below), and university scientists. The sessions followed the inquiry-based 5E learning cycle model (Bybee &

Landes, 1988) while simultaneously introducing pedagogy and science content (*Active Learning*).

Sixteen Support Teachers, elementary teachers who were given full time release from teaching responsibilities, provided assistance to classroom teachers implementing science inquiry, helped teachers with district assessments, and executed their district action plans for improving science literacy (*Collective Participation*). Support Teachers received more than 200 contact hours of leadership training in the form of a two-week Summer Institute, two graduate courses, a staff retreat, and a spring conference (*Duration*).

Professional development was sustained during the academic year by focusing on the implementation of the adopted curriculum and assessments (*Coherence & Duration*). Depending on the grade level, science was typically taught 3-4 days per week for approximately 45-60 minutes each day. The Support Teachers visited an assigned cohort of teachers biweekly and provided assistance with science curriculum preparation, gave strategies for teaching science, supplied science content background information (if necessary, with the help of the university scientists), assisted with classroom and district science performance-based assessments, modeled science lessons, and offered peer coaching for the classroom teacher (*Collective Participation*). Each teacher conducted a "research lesson" - a Japanese-style lesson study that involves the teacher writing a lesson in the 5E learning cycle model and writing a two-page reflective analysis of the lesson identifying specific strengths and weaknesses (*Active Learning*). These academic year activities provided approximately 24 additional hours of professional development spread evenly over the academic year (*Duration*).

All Principals participated in a one-day retreat and follow-up sessions throughout the academic year (*Collective Participation*). Model lessons were presented, and Principals were made aware of science education reform research. Additionally, the project leaders solicited Principal support for the project and their input on the challenges of implementing science reform. Support Teachers scheduled two local community meetings to involve city leaders, parents, and local principals in this science reform effort. These meetings took many forms - i.e., family science days, parent-teacher organization meetings, and state achievement test information sessions (*Coherence*).

A previously published report (Czerniak, Beltyukova, Struble, Haney, & Lumpe, 2006) described the project in detail and demonstrated the impact of the professional development activities on student achievement. State science achievement test scores for over 8,000 student across 43 elementary school buildings were tracked over the life of the project. Statistical comparisons were made on test scores from before and during implementation of the project. It was found that when controlling for prior achievement, science test scores improved significantly after implementation of the project. A cumulative effect was also found - students who had consecutive years of trained teachers outperformed students who were not exposed to multiple years of trained teachers. School buildings with greater degrees of project implementation in terms of contact hours outscored schools with less involvement. This finding, while focusing on school building averages, primarily related to duration which is one characteristic of professional development as noted by Desimone (2009). The aforementioned study did not seek to explore relationships between teachers' beliefs and student achievement, the foci of this particular study.

Methods

Approximately 450 elementary teachers who participated in the professional development activities were used to answer Research Questions 1 and 2 which focused on changes and predictors of teachers' beliefs about teaching science. For Research Question 3 regarding the relationship of teacher beliefs to their students' achievement, 4^{th} and 6^{th} grade students who took the science achievement test (described below) were matched to participating teachers resulting in a sample of 580 4^{th} grade students and 1,369 6^{th} grade students.

Teachers' beliefs were measured using the *Science Teaching Efficacy Beliefs Inventory* (STEBI) (Riggs & Enochs, 1990) and the *Context Beliefs About Teaching Science* (CBATS) instrument (Lumpe, Haney, & Czerniak, 2000). Both instruments demonstrated strong construct validity and reliability results when used with elementary teachers. These belief scales were administered to the teachers prior to and after participation in one year of the professional development project.

The STEBI survey included two belief scales, self-efficacy and outcome expectancy which, based on the developers, were treated as two separate constructs. A sample item for self-efficacy is, *"I wonder if I have the necessary skills to teach science."* A sample outcome expectancy item is, *"The teacher is generally responsible for the achievement of students in science."*

The CBATS survey included two belief scales, enabling and likelihood, which were combined into one score indicating a teacher's beliefs about the supportiveness of their professional context. A sample enable item is, *"Team planning time with other teachers would enable me to be an effective teacher."* A sample likelihood item is, *"How likely is it that professional staff development on teaching (workshops, conferences, etc.) will occur in your school?"*

The raw scores for both belief instruments were subjected to Rasch analysis (1980) for measurement in the social sciences. Rasch analysis helps overcome the major shortcoming of raw scores – their ordinal nature and sample and instrument dependency – and converts them to equal-interval units for more accurate statistical analysis.

In addition to the belief scales, a survey designed to gather demographic information about the teachers was administered at the beginning of the project. Demographics, which were previously related to science teaching self-efficacy beliefs (Jones & Carter, 2007), included gender, grade level, years of experience, educational degree, number of days a week teaching science, and length of a science lesson.

Student achievement was measured using the state achievement test for science – the Ohio Proficiency Test. This test, carefully aligned with state standards and developed using valid test construction methods, was administered to all 4^{th} and 6^{th} grade students in the state. It included items on life science, earth/space science, physical science, and science inquiry that were aligned with the state science standards. Items were commonly presented as a scenario where a diagram or data was provided and a series of related questions were asked. This test was used because it served as an annual, common, and mandated measurement of science achievement for all students which was readily available to the participating schools. Achievement data for students were collected at the end of the school year in which their teachers were participating in the professional development program.

Statistical analyses included paired t-tests and multiple regression analyses using SPSS.

Results

Research Question 1. Do teachers' beliefs about teaching science improve after professional development?

After participating in the professional development program for one year, the teachers displayed significantly more positive self-efficacy beliefs (t = 12.03, p = .000, df = 446). A slight, yet significant, drop in context beliefs was noted (t = -4.53, p = .000, df = 450). No significant gains in outcome expectancy beliefs were found (t = 1.23, p = .22, df = 445).

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Research Question 2. What factors predict teachers' beliefs?

Since self-efficacy and context beliefs significantly changed after participating in the project, these variables were subjected to regression analyses to determine factors that predicted these beliefs. Multiple regression analysis was used to test if measured background factors predicted science teaching efficacy beliefs. The results of the regression indicated that two predictors explained 10.3% of the variance (R^2=.327, F(2,443)=26.53, p=.000). The variables that predicted teacher self-efficacy beliefs were the number of times a week that science is taught and teacher gender (see Table 2). Teacher gender was a negative predictor, meaning that being a male predicted higher efficacy scores.

Multiple regression analysis was used to test if measured background factors predicted science teaching context beliefs. The results of the regression indicated that only one predictor explained 2.9% of the variance (R^2=.177, F(1,445)=14.36, p=.000). The number of times a week that a teacher indicated that they teach science was the only significant predictor of teacher context beliefs scores. See Table 3 for context belief regression results.

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Research Question 3. Are teachers' beliefs about teaching science predictive of student achievement?

Using students' achievement scores matched to participating teachers, regression analysis of the teacher beliefs on student achievement revealed that both STEBI subscales (self-efficacy and outcome expectancy) and the number of professional development hours teachers participated in were significant predictors of their student's achievement in the 4th grade ($F(3,576)=9.43$, $p=.000$). Outcome expectancy scores were a negative predictor of student achievement while self-efficacy and professional development hours were positive predictors of student achievement (see Table 4). Altogether, these three variables accounted for slightly more than 4% of the variance in student test scores ($R^2 = .042$).

For 6th grade students, regression analysis of the teachers' beliefs on student achievement revealed that self-efficacy beliefs, context beliefs, and number of hours of teacher professional development were significant, positive predictors of student achievement $F(3,1365)=19.71$, $p=.000$). See Table 5 for regression results. Altogether, these three variables accounted for almost 4% of the variance in student test scores ($R^2 = .039$). Outcome expectancy scores did not predict student achievement in the 6th grade.

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Discussion

In this study, it was found that elementary teachers who participated in a long-term, intense (over 100 contact hours annually) science professional development program displayed significant gains in their science teaching self-efficacy. No gains in outcome expectancy beliefs were found. Context beliefs decreased slightly after participation. Several background variables were found to be predictive of teacher beliefs including how often teachers spend teaching science. Males tended to display more positive beliefs than their female counterparts. Although a small portion of the variance was explained, teacher beliefs and the number of hours participating in the research-based professional development program were significantly predictive of students' science achievement.

As found in earlier studies, teaching self-efficacy is positively related to student achievement (Goddard, Hoy, & Hoy, 2004; Ross, Hogaboam-Gray, & Hannay, 2001). That relationship was further supported in this study. In one observational study of teacher's classrooms, Haney, Lumpe, Czerniak, and Egan (2002) found that teachers' classroom practices were consistently aligned with their belief systems. Researchers are encouraged to go one step further and conduct controlled studies demonstrating the causal links between teacher beliefs, classroom practice, student beliefs, and ultimately student learning.

The decrease in the teachers' context beliefs after participating in the intense professional development program is curious considering the amount of support systems provided including curriculum materials, Support Teachers, and ongoing training. One explanation may lie in the fact that many of the elementary teachers did not actively teach science prior to the project. The No Child Left Behind legislation in the United States caused elementary schools and teachers to emphasize reading and mathematics at the expense of other subjects including science. When the schools in this particular study received large external funding from a federal agency and adopted inquiry-based instructional materials, an increased expectation to regularly teach science was realized. Participation in the intense professional development and classroom application of teaching science, may have brought about an awareness of issues related to teaching science that they never before considered. Such issues may include the time it takes to teach science effectively, management of the hands-on kit materials, and classroom time taken away from the core subjects of math and reading. Prior to the project, it was not uncommon for the elementary teachers to teach science at all. After adoption of the science curriculum materials, and implementation of the externally funded professional development program, teachers were now expected to teach science several days per week. Such added stress may only serve to decrease beliefs in the context.

The number of hours that teachers participated in professional development was found in this study to be a predictor of student science achievement as measured by the state mandated test. This finding, coupled with other studies (Wayne, Yoon, Zhu, P., Cronen, & Garet, 2008) reiterates the notion that the time teachers spend in quality professional development can have an positive impact on teachers and students. Wayne et. al. found that between 30-100 hours of professional has the greatest impact on teachers and students. Yet, the debate remains about how much time is actually sufficient. The project described in this study was intense in that it required upwards of 100 hours during one year’s period. Some may argue that the time devoted to elementary science detracted from other core subjects or issues.

The professional development project described in this study is a direct application of effective principles outlined by Desimone (2009), Loucks-Hoursley, et al (2003) and Haney and Lumpe (1995). By focusing on standards-based goals, preparing teachers in both content and pedagogy related to these goals, and providing numerous support structures, the trained teachers possessed higher belief systems about teaching science. In addition, the students of the trained teachers demonstrated higher achievement performance (as reported in Czerniak, Beltyukova, Struble, Haney, & Lumpe, 2006).

While statistically significant, a small amount of variance in student's science achievement was explained by the teacher's beliefs. Obviously, other factors are involved and should be investigated. These factors may include actual classroom practices, curriculum materials, support systems, and student background variables.

Well designed and implemented professional development activities have the potential to increase teachers' beliefs about teaching science. Theoretically (Ford, 1992; Lumpe, Haney, & Czerniak, 2000; Goddard, Hoy, & Hoy, 2004), such beliefs may play a role in the quality of teaching and ultimately, student learning. The approaches used in the described program were designed to identify and positively impact teachers' beliefs. These approaches included opportunities to try new teaching strategies in their classrooms while receiving high levels of support. Bandura (1997) outlined four principal sources of beliefs, mastery experiences, vicarious experiences, verbal persuasion, and affective states (p. 79). Each of these sources may purposefully be targeted in order to develop positive and robust beliefs leading to more effective functioning in the classroom. Mastery experiences for teachers may include opportunities to apply effective teaching strategies and experience student learning success. Such experiences were present in the described professional development project and the specific result from this study that the number of times teaching science per week was a predictor of efficacy beliefs supports this part of Bandura's theory. Observing successful master teachers can provide vicarious learning experiences. Engaging in logical discussions about standards, curriculum, and effective instruction may help persuade teachers to align their teaching with policy and research-based recommendations. Teacher's affective states about teaching science, or emotional tone, may impacted by a variety of factors including resources, support systems, and reward systems.

The sources of effective functioning defined by Bandura are inherent in current teacher professional learning community models (Dufour, 2005). Many professional learning community protocols exist including peer coaching/teacher leadership (Reeves, 2006; Danielson, 2006), Collaborative Analysis of Student Work or CASL (Langer, Colton, and Goff, 2003, Critical Friends Groups (http://www.nsrfharmony.org/faq.html), and Japanese Lesson Study (Lewis, Perry, & Murata, 2006). These protocols utilize similar strategies including reflective inquiry, social norm setting among professionals, using student assessments to target learning gaps, and modifying instruction to address the identified gaps.

Professional development developers and providers should carefully plan and deliver programs for teachers. Principles of effective teacher professional development proposed by Desimone (2009) and Loucks-Hoursley, et al (2003) could be used as frameworks when designing programs that may impact teacher knowledge, skills, beliefs, and ultimately student learning. Funding agencies should prioritize programs that utilize proven professional development methods. Only then can the great expenditures be justified and ultimately student achievement impacted positively.

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Table 1. Teacher Belief Pre-Post Project Participation Comparisons (Rasch Scores)

	Paired Differences					
	Mean	Std. Dev.	Std. Error	t	df	Sig. (2-tailed)
Pre-Post Self-Efficacy	.21	.38	.02	12.03	446	.000
Pre-Post Outcome Expectancy	.01	.18	.01	1.23	445	.220
Pre-Post Context Beliefs	.05	.21	.01	-4.53	450	.000

Table 2. Regression Coefficients for Predictors of Teacher Self-Efficacy

	Unstandardized Coefficients		Standardized Coefficients		
Model	B	Std. Error	Beta	t	Sig.
Constant	3.16	.084		37.44	.000
Gender	-.28	.07	-.18	-3.98	.000
# times teach science/week	.10	.02	.26	5.83	.000

Table 3. Regression Coefficients for Predictors of Teacher Context Beliefs

	Unstandardized Coefficients		Standardized Coefficients		
Model	B	Std. Error	Beta	t	Sig.
Constant	3.01	.03		117.73	.000
# times teach science/week	.03	.01	.18	3.79	.000

Table 4. Regression Coefficients for Teacher Predictors of 4th Grade Science Achievement

	Unstandardized Coefficients		Standardized Coefficients		
Model	B	Std. Error	Beta	t	Sig.
Constant	245.20	33.59		7.30	.000
Outcome Expectancy	32.38	9.95	-.14	-3.25	.001
Self-Efficacy	11.84	3.75	.13	3.16	.002
Hours of Prof. Dev.	.085	.02	3.50	3.50	.001

Table 5. Regression Coefficients for Teacher Predictors of 6th Grade Science Achievement

	Unstandardized Coefficients		Standardized Coefficients		
Model	B	Std. Error	Beta	t	Sig.
Constant	104.35	14.43		7.23	.000
Context Beliefs	19.00	4.70	.114	4.25	.000
Self-Efficacy	5.28	1.43	.098	3.68	.000
Hours of Prof. Dev.	.087	.02	.114	4.25	.000